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## Plumage variation and geographical distribution in the Kalij and Silver Pheasants

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The genus *Lophura* Fleming consists of ten species of fowl-like pheasants, commonly called gallo-pheasants. They are distributed along the Himalaya east of the Indus River to Bhutan and then on through Burma, Thailand, Laos, Cambodia and Vietnam to China (including Hainan) and also through Peninsular Malaysia to Sumatra and Borneo (Howard & Moore 1984, Sibley & Monroe 1990).

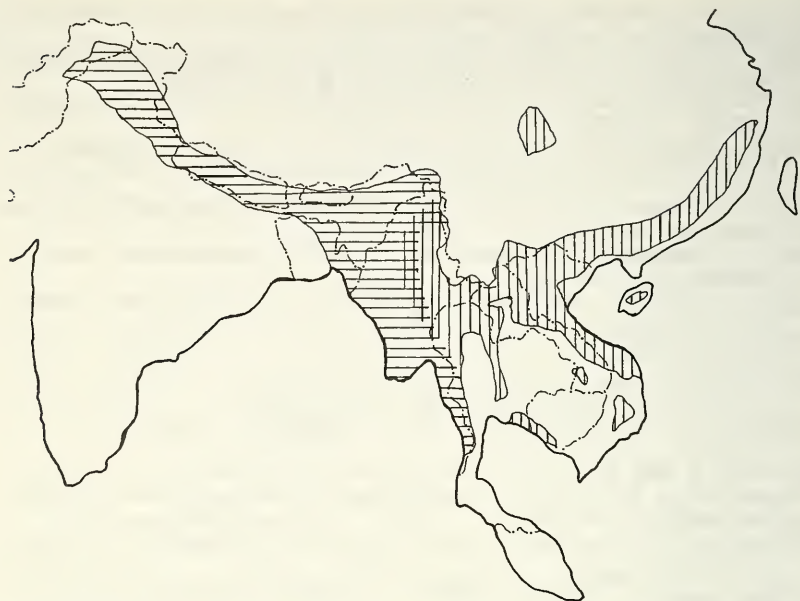


Figure 1. Map of South-east Asia with political boundaries (broken lines) to show the distribution of the Kalij Pheasant *Lophura leucomelanos* (area shaded by horizontal hatching to the left) and Silver Pheasant *L. nychthemera* (area shaded by vertical hatching to the right) according to Delacour. The River Irrawaddy and its western tributary, the Chindwin, are indicated near the junction of the two distributions (heavy lines). After Delacour (1977) and Johnsgard (1986).

In his review of the genus, Delacour (1949) suggested that two of the species, the Kalij Pheasant *L. leucomelanos*\* Latham and the Silver Pheasant *L. nychthemera* Linnaeus, form a superspecies within the genus *Lophura*. The Kalij Pheasant inhabits the forest and jungle of the Himalaya at moderate altitudes and is also found in the hilly regions of Burma and western Thailand. The Silver Pheasant is distributed throughout the mountains east of the River Irrawaddy, from Burma to Indochina, continental China and Hainan (Fig. 1).

Delacour (1949) listed 9 subspecies of Kalij Pheasant and 13 of Silver Pheasant, with hybrid zones between the two species occurring at several localities east of the Irrawaddy. Some of his subspecies had been described previously, often as distinct species; others Delacour proposed himself. All his subspecies were distinguished principally by differences in plumage, and were said to be geographically distinct.

Much of the earlier classification of pheasants had been based on specimens collected from isolated localities. As was often the case, the

\*Sibley and Monroe (1990, p. 19) state that the correct spelling is *leucomelanos* rather than the more widely used *leucomelana*.

TABLE 1

Named subspecies of the Kalij Pheasant *L. leucomelanos* and Silver Pheasant *L. nychthemera* in the BM(NH) collections at Tring with the number of specimens examined and our assigned plumage categories

BM(NH) specimens labelled as:	Number of individuals	Plumage category
<i>L. leucomelanos</i> Latham		
<i>hamiltoni</i> J. E. Gray	22	1
<i>leucomelanos</i> Latham	7	1
<i>melanota</i> Hutton	12	2
<i>lathamii</i> J. E. Gray	13	1
<i>williamsi</i> Oates	15	4
<i>lathamii/williamsi</i>	17	3(7), 4(10)
<i>oatesi</i> Ogilvie-Grant	2	5
<i>lineata</i> Vigors	14	5
<i>lineata/crawfurdi</i> J. E. Gray	6	5
<i>L. leucomelanos/L. nychthemera</i>	20	3(1), 6(19)
<i>L. nychthemera</i> Linnaeus		
<i>rufipes</i> Oates	8	6
<i>rufipes/occidentalis</i> or		
<i>occidentalis</i> Delacour	7	6
<i>ripponi</i> Sharpe	5	6
<i>ripponi</i> (syn. <i>jonesi</i> Oates)	5	6
<i>beaulieui</i> Delacour	4	6
<i>nychthemera</i> Linnaeus	6	6
<i>fohkiensis</i> Delacour	7	6
<i>engelbachi</i> Delacour	2	6
<i>beli</i> Oustalet	1	6

description of trivial differences from type specimens had resulted in the erection of a multiplicity of new taxa. In his review, Delacour attempted a taxonomic reappraisal of the Kalij-Silver Pheasant complex, but some features of that reappraisal are at odds with the taxonomic and geographical data. In the present study geographical variation in the plumage pattern of the upperpart plumage of the male is investigated. It was primarily the male plumage that Delacour used to establish his taxa and hence indicate relationships. A clear picture of this variation across the geographical range of this complex will provide a realistic background for an analysis of relationships between birds from various localities.

### Materials and methods

The present study was based on 173 specimens in the collection of the British Museum (Natural History)—now the Natural History Museum—at Tring. A list of these specimens labelled according to Delacour's system of subspecies, together with the number inspected in each subspecies and in each of our plumage categories, is given in Table 1.

The collections at Tring include at least one adult male specimen of each of the named subspecies of both *L. leucomelanos* and *L. nycthemera*, except for *L. l. moffitti*, *L. n. lewisi*, *L. n. annamensis*, *L. n. berliozzi*, *L. n. whiteheadi*, plus the two recently named Chinese subspecies *L. n. omeiensis* and *L. n. rongjianensis*. Of these, *L. n. moffitti* is known only from several pairs shipped from Calcutta in 1934 (Delacour 1977) and a single male collected from Bhutan (Ali & Ripley 1984); *L. n. lewisi* and *L. n. annamensis* both occur at the southeastern limit of that species' range in southwestern Cambodia and southern Vietnam respectively; *L. n. berliozzi* is "intermediate between *beaulieui* and *engelbachi* ..." and occurs in central Vietnam and Laos, *L. n. whiteheadi* "resembles *nycthemera*" (Delacour 1949) and is from the island of Hainan. According to Tan & Wu (1981) "our new subspecies [*L. n. rongjiangensis*] resembles *L. n. beaulieui* and *L. n. nycthemera*".

The whole BM(NH) collection was inspected and a series of specimens (termed voucher specimens by Monroe & Browning 1992) from all the represented subspecies was laid out for direct comparison. A sample was chosen, representing all clearly distinguishable plumage patterns from both species. The reference sample was then used as a 'type series' to which most specimens having significant locality data were compared. In this study, as in other similar ones (e.g. Monroe & Browning 1992), direct comparison of specimens was essential, because published descriptions of colour and pattern are invariably inadequate.

In comparing specimens with the reference sample, each specimen was assigned to a reference pattern on the basis of its plumage. This assignment was added to the label data, *viz* locality, date, original taxonomic name and current subspecies.

## Results

The reference sample consisted of 23 adult male plumage patterns (=reference patterns) and included at least one specimen from each named subspecies present at Tring, but where there was seen to be variation within a subspecies more than one specimen was included. The 23 patterns fell into six major categories, as follows:

- (1) Feathers of the upper back blue/black to brown, those of the lower back and rump blue/black to brown with a broad white terminal band (Fig. 2).

- (2) Back completely blue/black with no terminal band to rump feathers (Fig. 2).

- (3) Feathers of the upper back blue/black, those of the lower back and rump blue/black with a broad white terminal band (i.e. as in category 1). Light spotting or vermiculation is evident on some feathers, particularly on the lower back and rump (Fig. 2).

- (4) Feathers of the upper back blue/black, those of the lower back and rump blue/black with a broad white terminal band. All feathers have white markings which follow the contour of the feathers; the markings vary from disrupted vermiculations to unbroken wavy lines. Many feathers exhibit both extremes of marking, with relatively



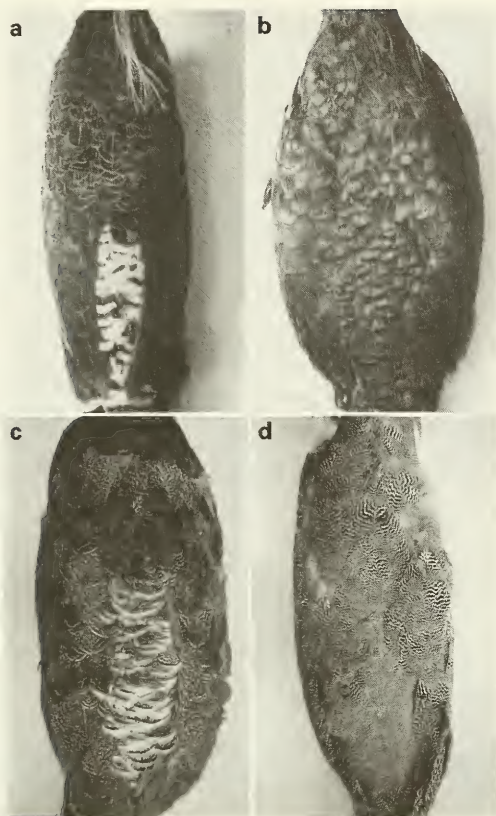


Figure 2. Gallo-pheasants, back and rump in dorsal view to show plumage categories: (a) category 1, (b) category 2, (c) category 3, (d) category 5. Photographs by permission of the British Museum (Natural History).

broad white lines towards the base, hidden under overlying feathers (Fig. 3).

(5) Feathers of the lower back lacking the white terminal band. Black and white lines follow the contours of the feathers and become very disrupted on the visible part of the feather (i.e. that not hidden by overlying feathers). The lines are less than 1 mm wide, which, together with the disruption towards the feather tip, gives the impression from a distance of being grey (Fig. 2).

(6) Feathers with black and white V-shaped markings, which in virtually all cases are much broader at the base of the feather than at the top. The number and width of lines vary. There is some disruption towards the feather tip in some cases (Fig. 3).

The geographical distribution of each of these plumage categories is mapped in Figure 4.



Figure 3. Gallo-pheasants, back and rump in dorsal view to show plumage categories: (a) and (b) extremes of category 4, (c) and (d) extremes of category 6. Photographs by permission of the British Museum (Natural History).

### Variation within major categories

The overall distributions of the category 1 pattern is, judging from the Tring specimens, from Dharamsala in the northwest, through Simla (31°7'N, 77°9'E), the Kumaon Himalaya (29–31°N, 78–81°E) and Nepal (27–31°N, 80–88°E), disappearing in Sikkim (27–29°N, 88–89°E), then reappearing in Bhutan and Manipur in the Eastern Himalaya (to about 24–26°N, 92–95°E) (Fig. 4).

There is a limited amount of variation within category 1 throughout its recorded range. Birds to the west of Nepal (i.e. west of 80°E) have white shafts to the feathers, whereas those from Bhutan (91°E) eastwards have black shafts. Furthermore, the terminal band to the feathers decreases in width from Dharamsala (76°E) to those specimens labelled "Nepal" (80–88°E) (most specimens from Nepal are not

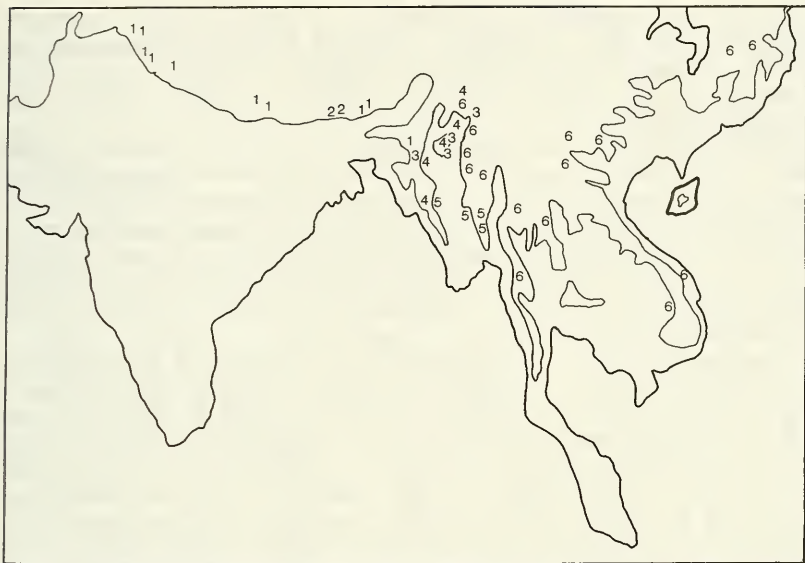


Figure 4. Map of South-east Asia showing localities from which our major plumage categories were recorded. Narrow line represents 1000 m contour.

further localised). Specimens labelled "Sikkim" ( $88-91^{\circ}\text{E}$ —category 2) lack the white terminal band, but it reappears east of Sikkim. There is, however, no apparent trend in band width towards the eastern extremity of the category range.

There is little variation within category 2. Some specimens do, however, have a very narrow band of white (about 0.5 mm) in the position of the terminal band. Category 2 birds occur within the range of those within category 1 and are restricted to the Sikkim valley ( $27-28^{\circ}\text{N}$ ,  $88-90^{\circ}\text{E}$ ) (Fig. 4).

Birds in category 3 are distributed from Tiddim in west-central Burma ( $23^{\circ}23'\text{N}$ ,  $93^{\circ}42'\text{E}$ ) northeast to Saidon (Myitkyina District) in northeastern Burma ( $25^{\circ}21'\text{N}$ ,  $97^{\circ}54'\text{E}$ ) (Fig. 4). They exhibit variation in both the extent of the white markings and also the distribution of these markings on the upper parts. From the limited sample there was, however, no evidence that patterns were arranged in a morphocline according to geographical position.

Birds in category 4 are distributed from the Arakan Hill Tracts of southwest Burma (about  $21^{\circ}30'\text{N}$ ,  $93^{\circ}\text{E}$  to  $21^{\circ}\text{N}$ ,  $94^{\circ}30'\text{E}$ ) throughout northeast Upper Chindwin to Saidon in Upper Burma ( $25^{\circ}21'\text{N}$ ,  $97^{\circ}54'\text{E}$ ). Most specimens, however, were recorded from the southwestern part of the range (Fig. 4). Category 4 birds vary quite considerably in the appearance of the lines on the feathers. In some specimens these lines are very disrupted, appearing almost spotted, whereas at the other extreme the lines are continuous throughout.



There is one exceptional specimen from Upper Chindwin in Burma which has four quite broad white lines per feather (reference pattern no. 10). Otherwise, the feathers have five to six narrow wavy lines. Again there is little correlation between feather pattern and geographical position.

Category 5 birds were recorded from east of the Irrawaddy in the Pegu Yomas (from Prome at 19°N, 95°E southwards) east to Chiang mai in Thailand (19°N, 99°E) and south to Tennasserim (14°N, 99°E) and Rahaeng (Tak). Within category 5, there is slight variation in the extent of the disruption of the lines on the feathers. In addition, the hidden portion of the feather varies in the clarity of the lines, with quite distinct broad lines in some specimens, but thinner and more wavy ones in others.

Category 6 birds are distributed from Myitkyina in Upper Burma (25°50'N, 97°30'E) in the north, south through the Shan States to Chaing Rai (19°56'N, 99°51'E), Na Noi (18°30'N, 100°30'E) and Pak Jong near Korat (15°N, 101°E) in Thailand. Eastwards, they occur through Xien-Khouang in Laos (19°21'N, 103°23'E), Tonkin in northern Vietnam (23°N, 105°E to 22°N, 107°E) to Fukhien in China (24°N, 116° to 28°N, 117°E). There are some specimens from the Boloven Plateau in southern Laos (15°N, 107°E) and Hue in southern Vietnam (16°28'N, 107°35'E). The specimens collected in the west, close to the Irrawaddy, are darker, with more black on the feathers than those further east. The darkest birds recorded are from Mogok (Ruby Mines 23°N, 93°30'E) and Myitkyina District, but very similar specimens also come from the southeastern limit of the range at Boloven Plateau and at Hue. The feathers are black or brown, with 4 to 6 white Vs of 1-2 mm width. The Vs on the lower back and rump feathers are rather more disrupted than those on the upper back.

East of the Irrawaddy, there are also some category 6 birds which approach the birds of category 5 in appearance. These former have a marked degree of disruption of the lines towards the feather tip, although this is not so pronounced as in category 5. The category 6 specimens with the highest degree of disruption of the lines were, however, recorded from Saidon in Upper Burma. To the east of Burma, the black lines on the feathers become increasingly indistinct, so that the birds appear increasingly white (Fig. 3).

### Geographical variation across major categories

The plumage patterns described above can be grouped into two major assemblages, consistent with the geographical distribution of the birds concerned. These assemblages are (1) the darker forms, usually with a white terminal band to the feathers of the lower back and rump (categories 1, 2, 3 and 4): all these may be assigned to *Lophura leucomelanos*, the Kalij Pheasant; (2) the generally lighter forms with a basic black and white V-pattern to the feathers and no white terminal band (categories 5 and 6): these may be assigned to



*L. nychthemera*, the Silver Pheasant. However, the two major plumage assemblages appear to be linked by specimens with feathers which have black and white V-shaped lines of equal width, the lines being more or less wavy, or slightly wider black lines (giving the appearance of white Vs on a black background). This feather pattern changes in three directions from the centre of the two species' aggregate range.

(a) To the west of the Irrawaddy River there is a cline of increasing disruption, and ultimately masking, of this pattern. All along the Himalaya the specimens are plain-backed and may or may not have a white terminal band to the feathers of the lower back and rump. Birds immediately to the west of the Irrawaddy (from Myitkyina southwest to Arakan Yomas) are at the southeastern end of this trend (category 4). Northwest of this area are found specimens which have the white markings as in category 4, but not distributed over the whole of the back or over the whole expanse of any given feather (category 3). These specimens are intermediate in appearance between category 4 and categories 1 and 2, which have no white markings other than the terminal band seen in category 1. Along the Himalaya, the plumage of the male upper parts varies but little, and is of category 1 type. The only exception is that of the completely dark-backed specimens from Sikkim, which are assigned to category 2.

To the east of the Irrawaddy two geographical trends are apparent.

(b) Moving southwards from the region of the Irrawaddy delta, the birds have an increasingly disrupted pattern and comprise our plumage category 5. The pattern of alternating black and white Vs becomes less distinct the further south the specimens occur.

(c) To the northeast of the Irrawaddy delta specimens are increasingly white, so that the whitest individuals occur in the extreme northeast. Traces of black are, however, never lost.

### Taxonomic significance

North of the Chindwin River/Irrawaddy River junction, some members of the western assemblage extend to the east of the Chindwin, although these specimens are at a low frequency. However, much further north, around the Myitkyina District and not far from the source of the Irrawaddy, the major assemblages seem to intermingle freely. Nevertheless in Lower Burma, where the Irrawaddy forms a formidable barrier there is, apart from a single specimen attributable to the eastern assemblage which was recorded from west of the river in the Arakan Yomas, no evidence of either major assemblage spanning the river.

Thus, as we note above, it seems to us reasonable to assign all specimens from west of the lower Irrawaddy to *Lophura leucomelanos* (Kalij Pheasant) and all those from the east to *L. nychthemera* (Silver Pheasant).

In 1977 Delacour recognised nine Kalij subspecies and fourteen Silver subspecies. The additional Silver Pheasant subspecies described since then (Tan & Wu 1981) was added to the list by Johnsgard (1986).

The validity of many of these subspecies must remain in doubt, particularly if they are founded on pattern alone. Delacour states that there are six Kalij subspecies west of the Irrawaddy (*L. l. lathami*, *williamsi*, *moffitti*, *melanota*, *leucomelanos* and *hamiltoni*). All but *moffitti* are included in our study. In Burma there appears to be no relationship between plumage pattern and geographical position. Many of the specimens concerned were claimed to be *williamsi* or *lathami*/*williamsi* intergrades. Birds from Bhutan and Manipur are *lathami*: any "intergrades" with *williamsi* are probably better placed within our category 3. We therefore suggest that all category 4 specimens should be referred to *williamsi*, because the variation occurring within this category appears to be unrelated to geographical position. This does, however, restrict the area of distribution for *lathami* compared to Delacour's attributions.

Along the Himalayan range, there is little variation in the plumage of the back in adult males (apart from the distinctive *melanota* of Sikkim), but there are other variable characters, and Delacour uses these to differentiate subspecies. For example, *L. l. hamiltoni* and *L. l. leucomelanos* (the westernmost subspecies) are the only subspecies which have white breasts. In all other specimens of both species the breast is black. *hamiltoni* is then distinguished by its unique white crest; *L. l. leucomelanos* and all other specimens of both species have black crests. Our use of male upper parts would not separate *hamiltoni* and *leucomelanos* from one another or from *lathami*, but we concede that these other characters are sufficiently important, and probably consistent enough, to characterise all three.

Delacour suggested that the southernmost individuals to the east of the Irrawaddy, from Lower Burma and western Thailand southwards, belong to three subspecies of Kalij (*L. l. oatesi*, *lineata* and *crawfurdi*). Once again there is little difference between them. What there is, is perhaps related to geographical position. They comprise our plumage category 5 and the specimens we have investigated suggest that their pattern is derived from that seen in the Silver Pheasants further north, but east of the Irrawaddy.

The whitest specimens (all in our plumage category 6) of the Silver Pheasant are claimed to belong to seven subspecies (*L. n. rufipes*, *occidentalis*, *ripponi*, *beaulieui*, *nycthemera* and *fohkiensis*: specimens labelled "*ripponi* (syn. *jonesi*)" are from localities northeast of the localities of those simply labelled "*ripponi*"—we treat them as *jonesi*). Our sample size is small but nevertheless it suggests that variation is simply clinal, with the whitest forms in the extreme northeast.

The darker Silvers are intriguing. It is surprising that the individuals from the Boloven Plateau in southern Laos and the specimen from Hue in South Vietnam should resemble some individuals from Upper Burma so closely, particularly since individuals which inhabit the area in between exhibit such variation in plumage. Delacour assigned birds from the southeast to *L. n. engelbachi* (Boloven Plateau) or *beli* (Hue), but claimed that specimens from Upper Burma are Kalij/Silver hybrids. With the exception of one of the latter, all still fall within our plumage category 6.

## Conclusions

Firstly we suggest that the most primitive plumage pattern occurs at the centre of the aggregate range of *Lophura leucomelanos* and *L. nycthemera* and that this pattern probably represents the ancestral (plesiomorph) condition for both species. In the Kalij Pheasant *L. leucomelanos* (to the west of the Irrawaddy River) this pattern has become disrupted and finally masked, leading to the plain-backed specimens of the Himalaya, which may or may not have a white terminal band to the feathers of the lower back and rump. In the Silver Pheasant *L. nycthemera* (to the east of the Irrawaddy) two geographical trends are apparent. Moving southwards from the region of the Irrawaddy delta, the birds have an increasingly disrupted pattern, whereas to the northeast they become increasingly white. Traces of black are, however, never lost.

If we have established that the Irrawaddy is an effective barrier between the two species, then the three subspecies *oatesi*, *lineata* and *crawfurdi* are Silver Pheasants, not Kalij Pheasants as maintained by Delacour, and are simply stages in a cline demonstrating increased disruption of the pattern southwards.

The seven white subspecies of *L. nycthemera* included in our study (*L. n. rufipes*, *occidentalis*, *ripponi*, *jonesi*, *beaulieui*, *nycthemera* and *fohkiensis*) appear to us to form another cline, which, on current evidence, does not merit separation into a series of distinct forms.

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